Hack Yourself First

Web Application Security

Agenda

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2. Top 10 Web Application Security Risks
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4. Broken Authentication
5. Sensitive Data exposure
6. Broken Access control
7. Security Misconfiguration
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10. Insecure Direct Object References

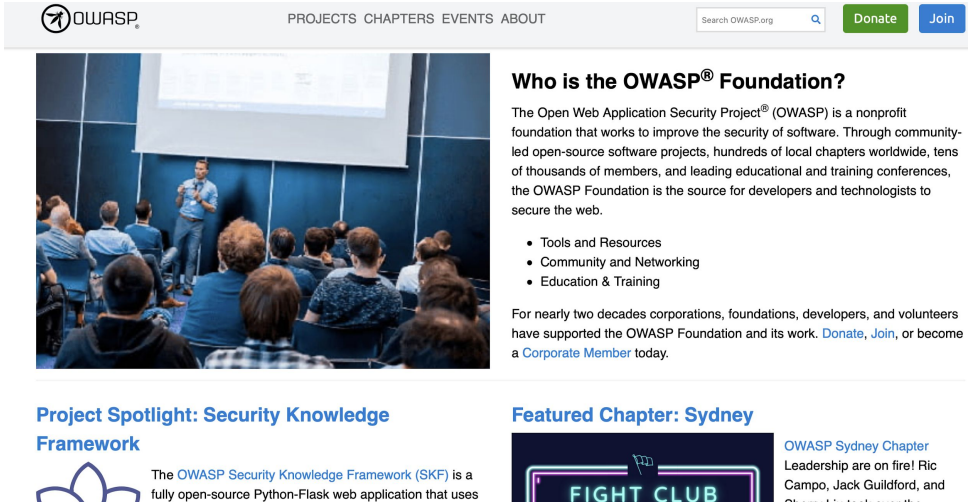
Demo

https://github.com/aglumova/web-security-workshop

OWASP

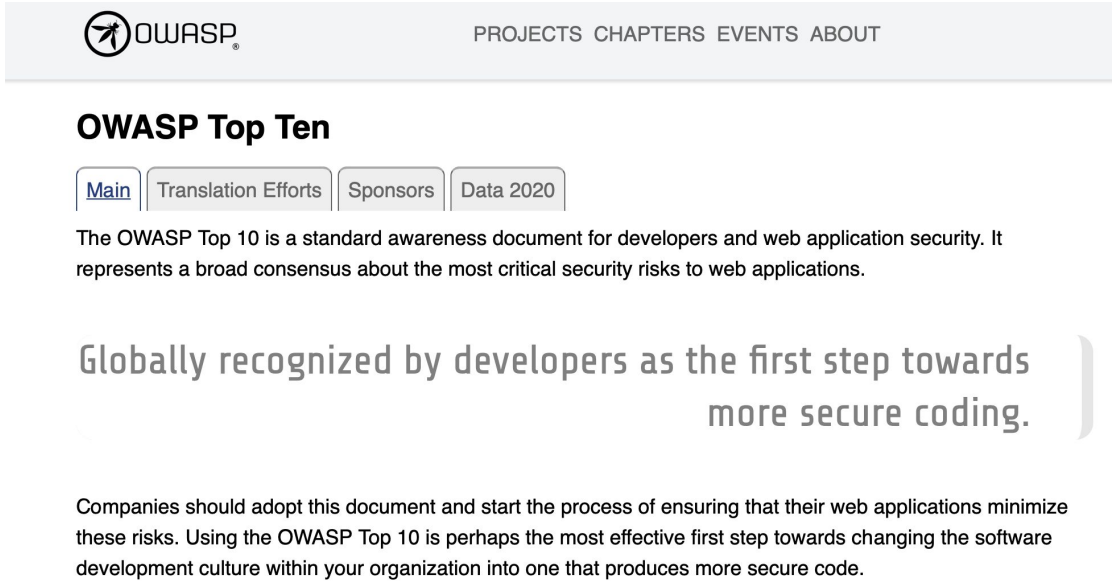
Open Web Application Security Project

https://owasp.org



Top 10 Web Application Security Risks

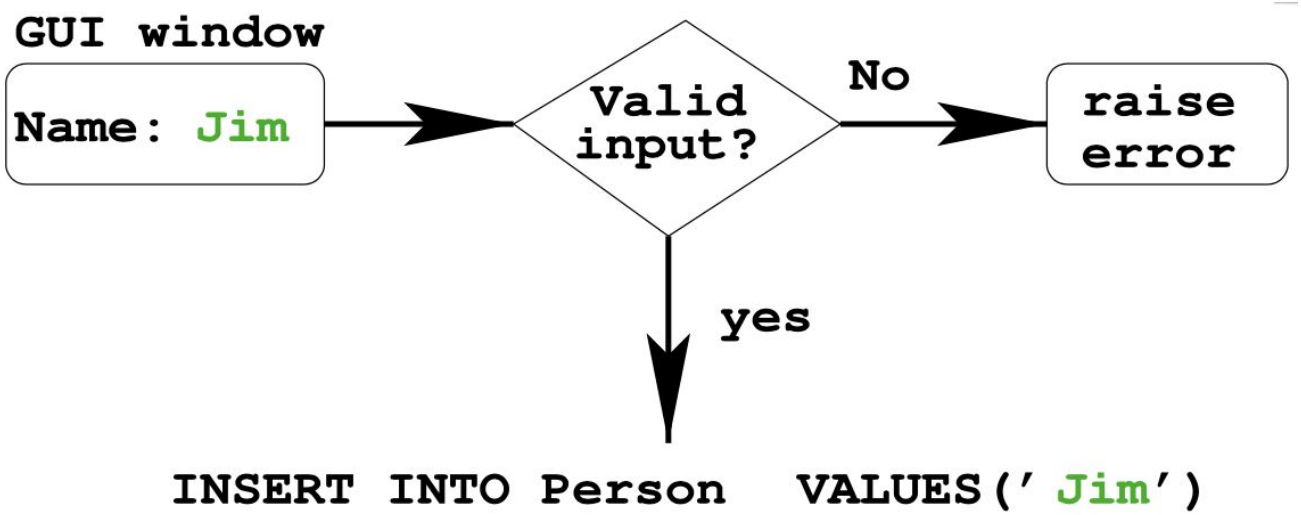
https://owasp.org/www-project-top-ten/



Injection

Injection (SQL, NoSQL, OS, LDAP)

Classic failure to filter untrusted input.

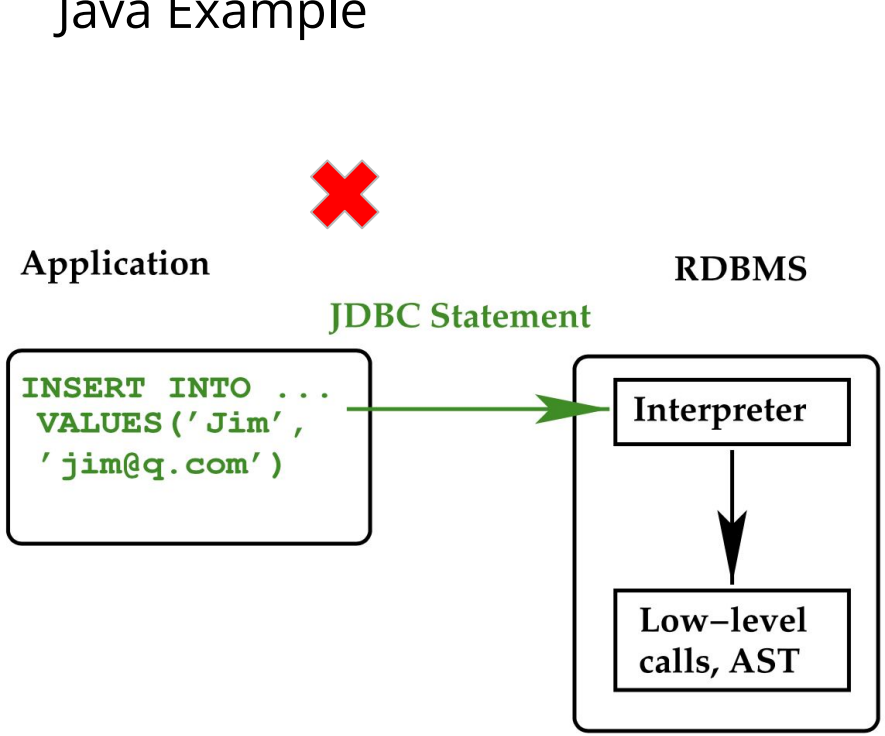


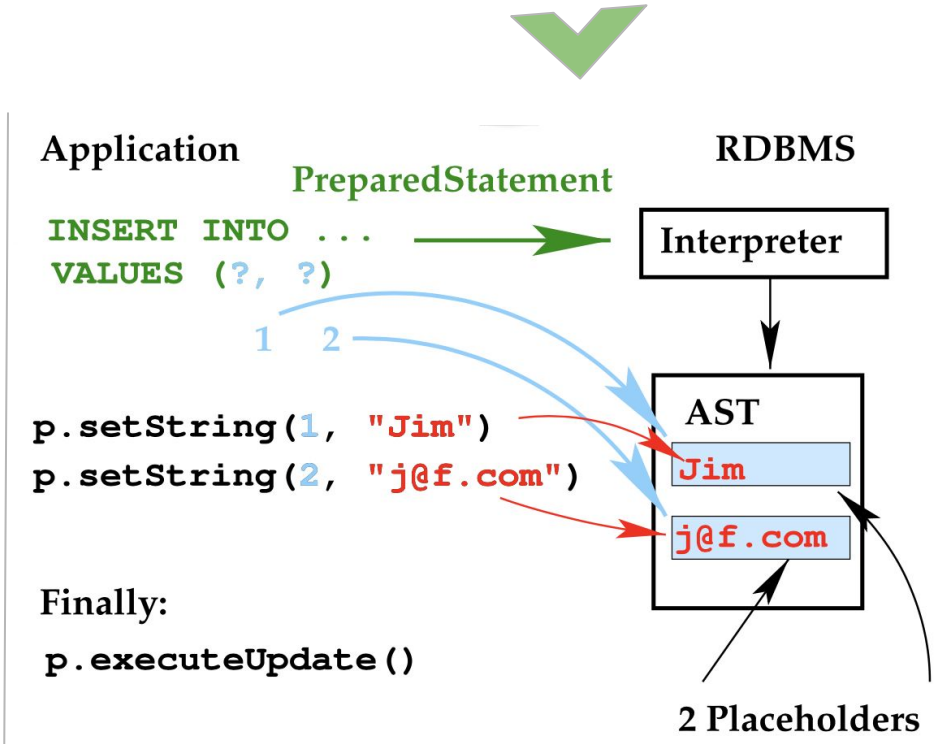
Prevention:

- White list filtering
- Trust your frameworks

SQL Injection

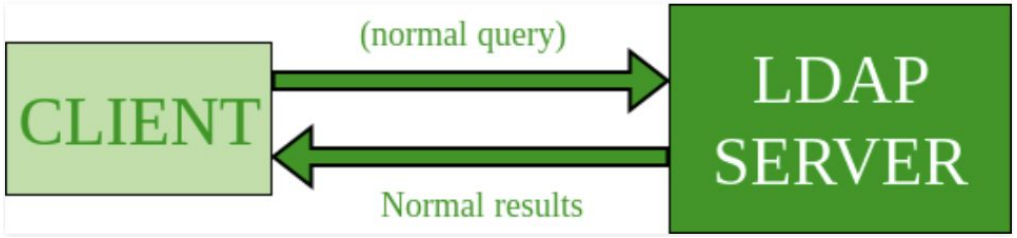
Java Example



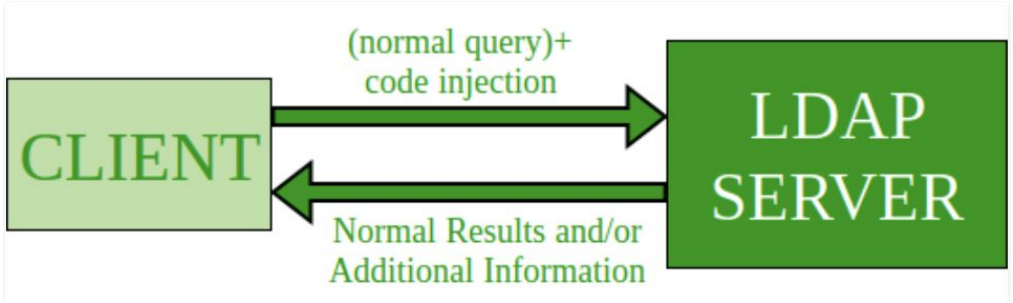


LDAP Injection

Normal Operation:



Operation with Code Injection:



Broken Authentication

Broken Authentication

1. The URL might contain the session id and leak it in the referer header to someone else.
2. The passwords might not be encrypted either in storage or transit.
3. The session ids might be predictable, thus gaining access is trivial.
4. Session hijacking might be possible, timeouts not implemented right or using HTTP (no SSL security).
5. Etc.

Prevention:

- **Straightforward:** Trust your frameworks
- **Roll your own code:** Be extremely paranoid and educate yourself on what the pitfalls are

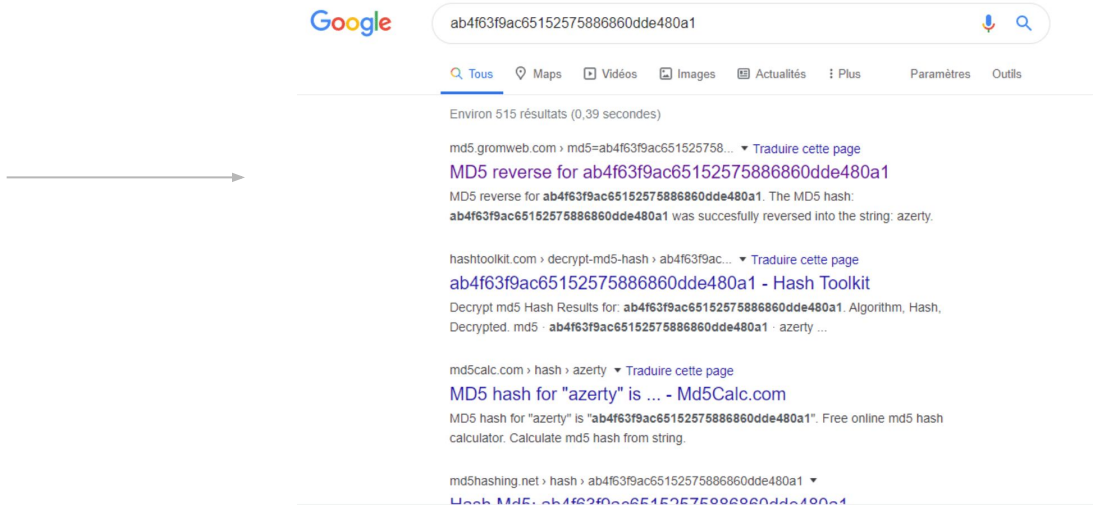
How to Store Password?

Worst: Store password as plain text

Bad: Obsolete Hash Function (md5, sha1…)

The LinkedIn site used to store part of its passwords with sha1, and after the hash leaks in 2012, it took only three days to recover 90% of the passwords.

Login	Password (md5)
admin	ab4f63f9ac65152575886860dde480a1
toto	21b72c0b7adc5c7b4a50ffcb90d92dd6
billy	47ad898a379c3dad10b4812eba843601
tata	21b72c0b7adc5c7b4a50ffcb90d92dd6
titi	5b9a8069d33fe9812dc8310ebff0a315



How to Store Password?

Bad: Inappropriate hash function (sha256, sha512, or sha3)

They are not suitable for storing passwords, because they are fast to calculate, as the following benchmark proves

Normal: Improving SHA512: Static and Dynamic Salt

User	Salt	Hash sha512 with salt
admin	BGdd6d6^ZgvkMhKf@W3RqT	7509d123bce1aa92331861cf8fd738a58205045123f0e25f
toto	HZBD^@gL*wvoExo6yJ7hVB	6b28830776de6ad7ef1dd8c221e0d53fec4532c623075d02
billy	wvVndjwcZJy!dwT4fBD@U^	2847b2605f6a1cd88399e6c9784c0e583799be9485cb128f
tata	QeNWm9NXqJ8m@m2^F7Kh9*	165bc06b69fa2bfcd893bfde86358394406c87c7f7abba89
titi	iQUemgw9M6Gw*&v6RG%MZ#	f8eded6c815c7522ab6197aa319d3ff4cddc2c7eeffa0f91

NOTE: In some resources Static Salt named - Pepper.

How to Store Password

Good: Increasing the Number of Iterations

```
As long as iteration is greater than 0
    hash = sha512(hash)
    Decrement iteration
```

Best:

- Merging the 3 Methods
- BCrypt

```
Function calculation_hash(password,salt,pepper,iteration)
Inputs
password is the user's password in plain text
salt is the unique salt per user and is randomly generated
pepper is the common pepper for all users and is randomly generated.
iteration is the number of iterations

Output:
The password hash
Hash = sha512(salt+password+pepper)
As long as iteration is greater than 0
    hash = sha512(hash)
    Decrement iteration

return hash
```

BCrypt

The hash computed by bcrypt has a predefined form:

$2y$11$SXAXZyioy60hbnymeoJ9.ulscXwUFMhbvLaTxAt729tGusw.5AG4C

1. **Algorithm:** This one can take several versions depending on the version of bcrypt (2, $2a$, $2x$, $2y$ and $2b$)
2. **The cost:** The number of iterations in power of 2.
3. **Salt:** Instead of storing the salt in a dedicated column, it is directly stored in the final hash.

Session hijacking

Session hijacking

Three common protection strategies against session fixation

- **Only use HTTPS**

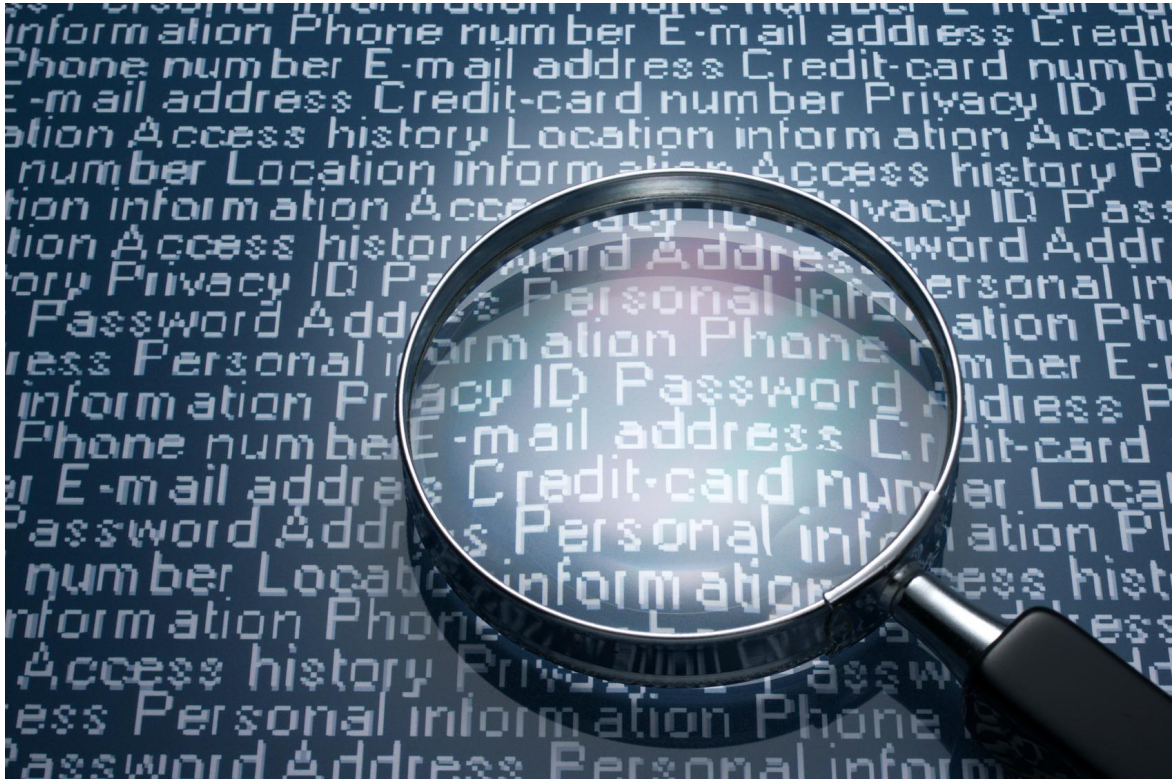
  Downside:

  - Increases processing overhead
  - Increases network traffic
  - Makes caches much less effective.

- **Once a user logs in, enforce HTTPS for future traffic.**

- **Secure HTTPS traffic with a secondary cookie**

Sensitive Data Exposure



Sensitive Data Exposure

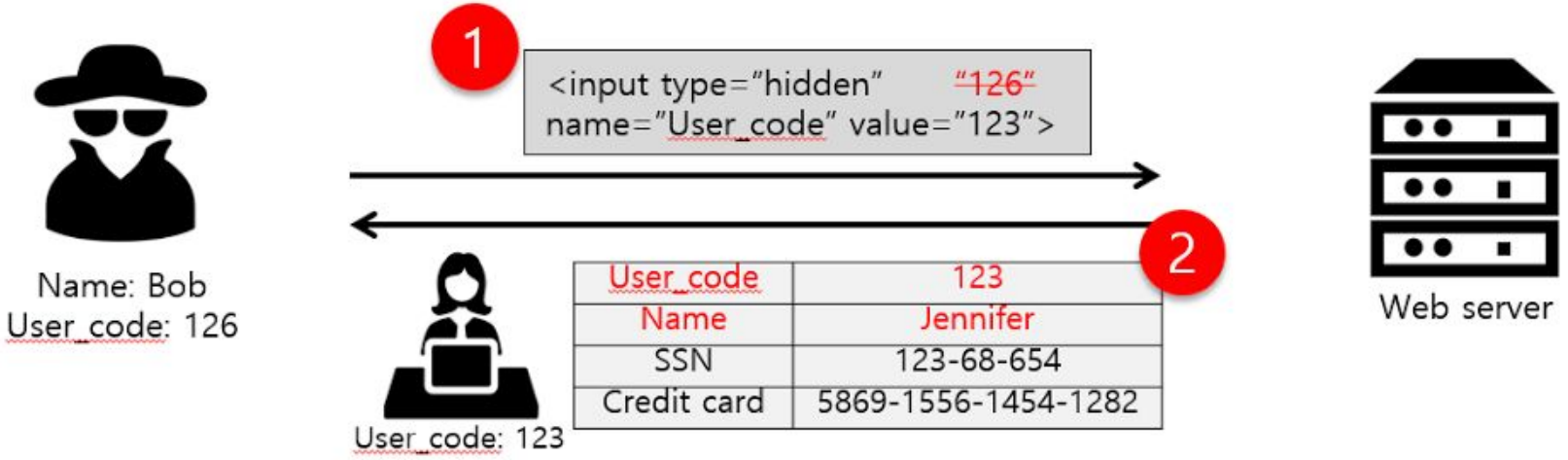
Sensitive data should be encrypted at all times, including in transit and at rest. No exceptions.

- session IDs and sensitive data **should not** be traveling in the URLs
- sensitive cookies **should have** the secure flag on

Prevention:

- *In transit:* Use HTTPS with a proper certificate and PFS (Perfect Forward Secrecy). Do not accept anything over non-HTTPS connections. Have the secure flag on cookies.
- *In storage:* **First** and foremost, you need to lower your exposure. Do not store credit card information *ever*, as you probably don't want to have to deal with being PCI compliant. Sign up with a payment processor such as Stripe or Braintree. **Second**, if you have sensitive data that you actually do need, store it encrypted and make sure all passwords are hashed. For hashing, use of bcrypt is recommended. If you don't use bcrypt, educate yourself on salting and rainbow tables.

Broken Access Control



Broken Access Control

- The application uses unverified data

```
http://example.com/app/accountInfo?acct=notmyacct
```

- An attacker simply force browses to target URLs

```
http://example.com/app/getappInfo
http://example.com/app/admin_getappInfo
```

Prevention:

- Deny access to functionality by default.
- Use Access control lists and role-based authentication mechanisms.
- **!**Do not just hide functions.

Security Misconfiguration

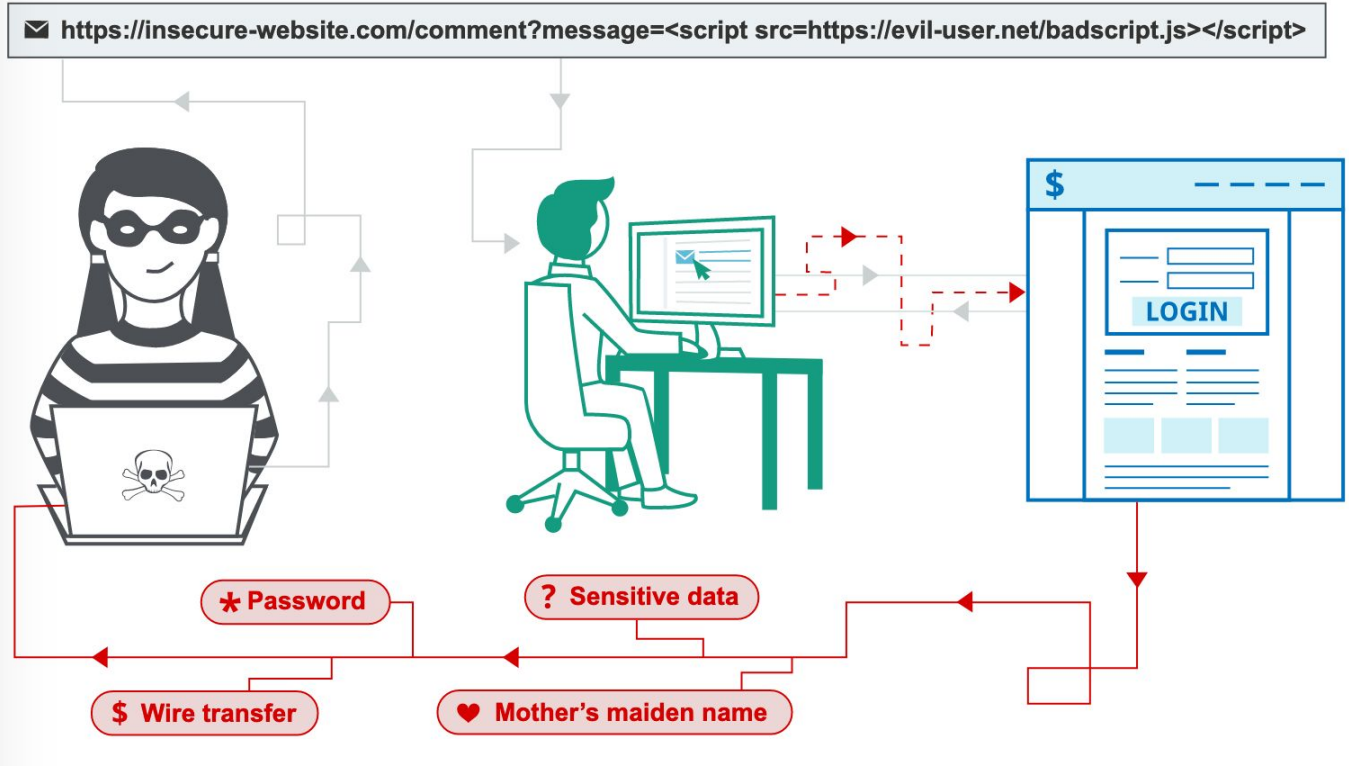
Security Misconfiguration

1. Running the application with debug enabled in production.
2. Having directory listing enabled on the server, which leaks valuable information.
3. Running outdated software.
4. Having unnecessary services running on the machine.
5. Not changing default keys and passwords. (Happens way more frequently than you'd believe!)
6. Revealing error handling information to the attackers, such as stack traces.

Prevention:

- Have a good "build and deploy" process, which can **run tests on deploy**.
- The poor man's security misconfiguration solution is post-commit hooks, to **prevent the code from going out with default passwords** and/or development stuff built in

Cross-Site Scripting (XSS)



Cross-Site Scripting (XSS)

- **Reflected XSS**, where the malicious script comes from the current HTTP request.

```
https://insecure-website.com/status?message=<script>/*+Bad+stuff+here...+*/</script>
```

```
<p>Status: <script>/* Bad stuff here... */</script></p>
```

- **Stored XSS**, where the malicious script comes from the website's database.
- **DOM-based XSS**, where the vulnerability exists in client-side code rather than server-side code.

```
var search = document.getElementById('search').value;
var results = document.getElementById('results');
results.innerHTML = 'You searched for: ' + search;
```



```
You searched for: <img src=1 onerror='/* Bad stuff here... */'>
```

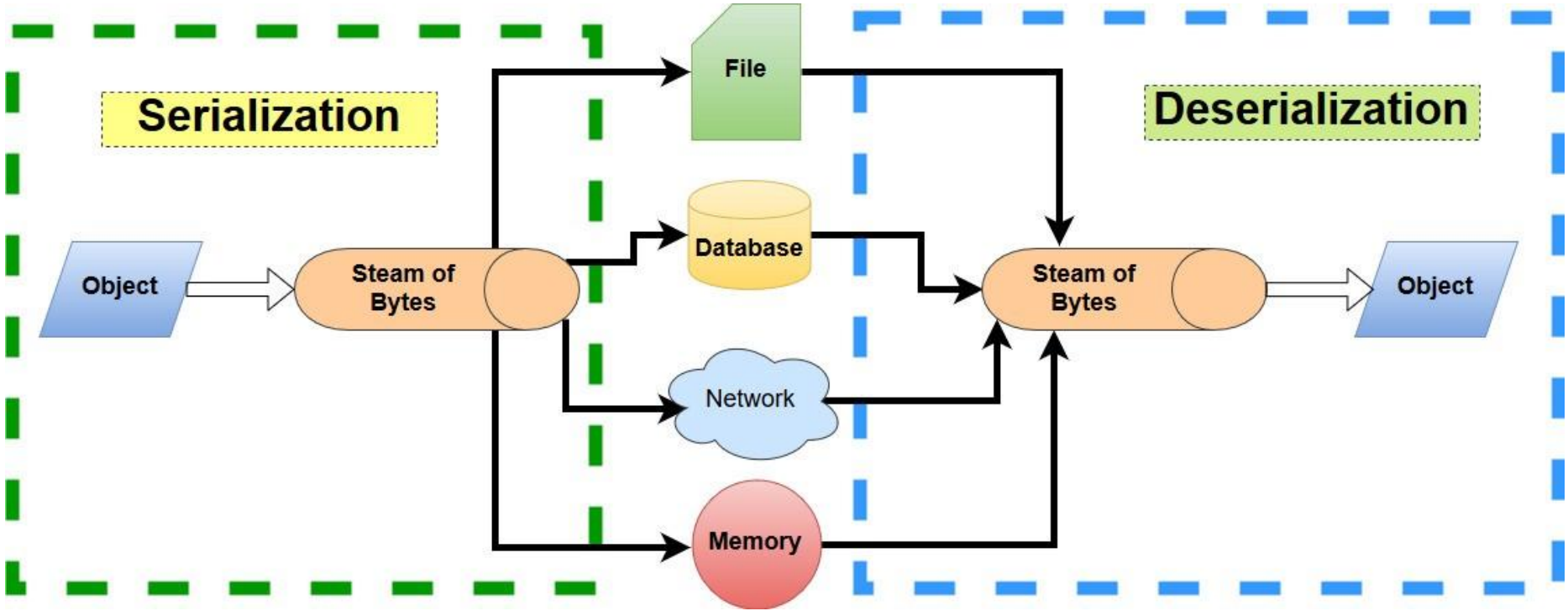
Cross-Site Scripting (XSS)

Prevention:

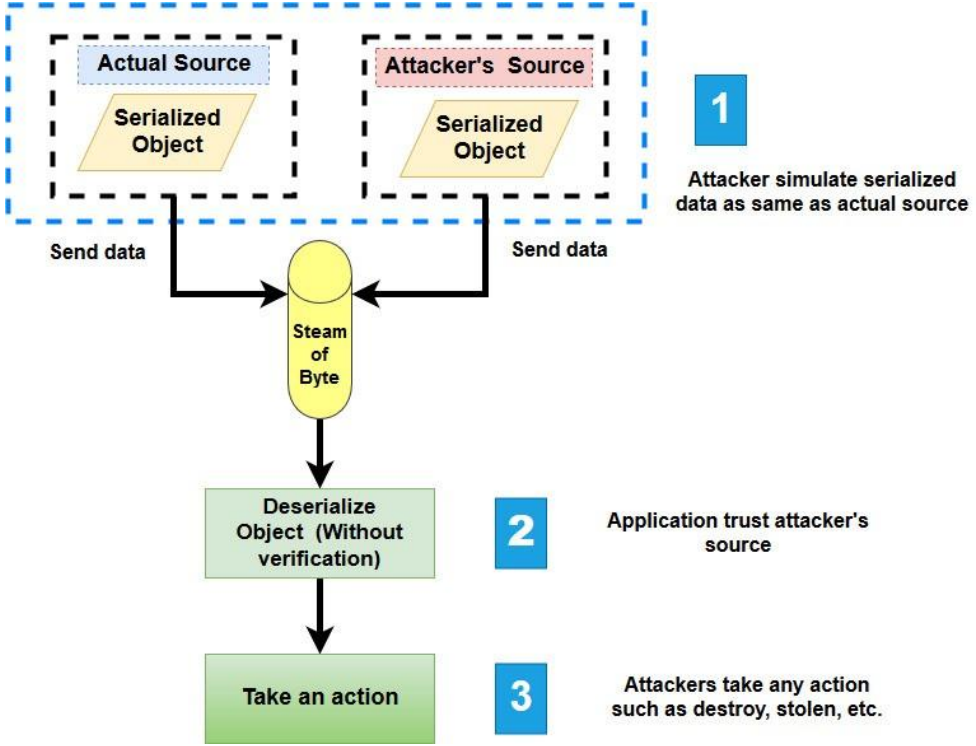
- Filter input on arrival.
- Encode data on output.
- Use appropriate response headers

  Content-Type and **X-Content-Type-Options** headers to ensure that browsers interpret the responses in the way you intend.

Insecure Deserialization



Insecure Deserialization



The vulnerability of applications always occurs from below

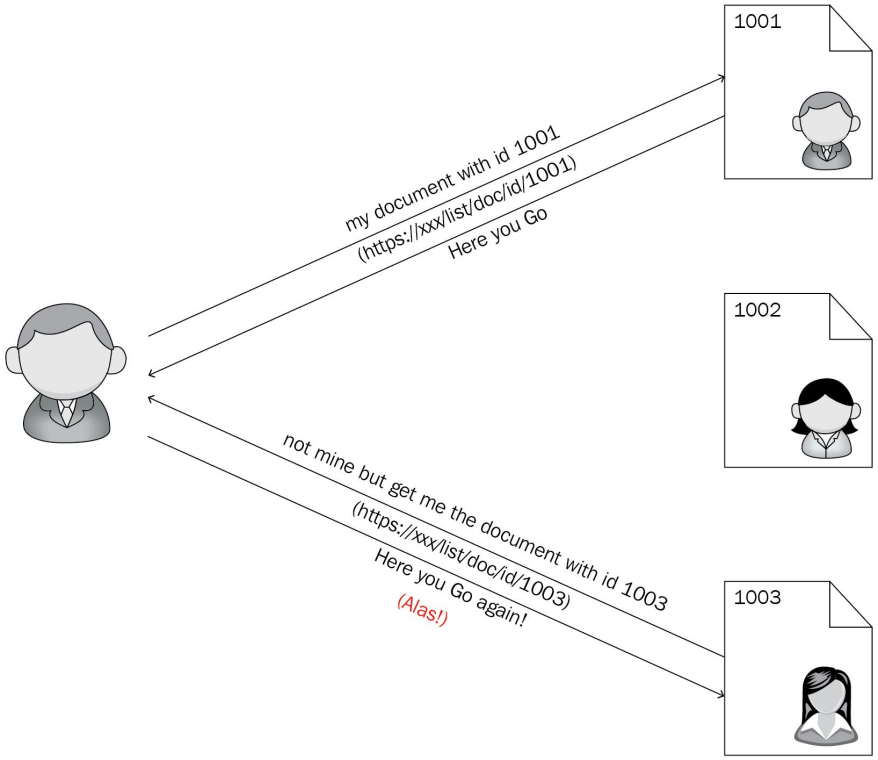
- read data from untrusted sources.
- read data without verification such as digital signature, unsafe classes

Insecure Deserialization

Prevention:

- Monitoring the deserialization process.
- Encrypting serialization processes.
- Not accepting serialized objects from unknown or untrusted sources.
- Running the deserialization code with limited access permissions.
- Using a firewall which can help detect insecure deserialization

Insecure Direct Object Reference



Insecure Direct Object Reference

Prevention:

- Do not use predicted ID’s outside the internal communication

From `userId=1<Number>` → To `userId=e45571e1-4cd8-4ebe-b051-f4fa17614807<GUID>`

- Strict access control checks to all resources